UNIVERSITI PUTRA MALAYSIA

CHARACTERISATION OF PRODUCTIVITY TRAITS OF SAHIWAL - FRIESIAN BREED GROUPS

MD AZHARUL ISLAM TALUKDER

CHARACTERISATION OF PRODUCTIVITY TRAITS OF SAHIWAL - FRIESIAN BREED GROUPS

By

MD AZHARUL ISLAM TALUKDER

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia
Fulfilment of Requirement for the Degree of Doctor of Philosophy

February 2002

DEDICATION

TO MY PARENTS (ALHAJ. MD. ALIMUDDIN TALUKDER AND LATE MRS. JAMILA KHATUN), WIFE (ARZUMAN AKHTER) AND SON (T. M. ABU JAWAD)

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

CHARACTERISATION OF PRODUCTIVITY TRAITS OF SAHIWAL - FRIESIAN BREED GROUPS

BY

MD.AZHARUL ISLAM TALUKDER

February 2002

Chairman: **Jothi Malar Panandam, Ph.D.**

Faculty: **Agriculture**

The dairy industry in Malaysia is mainly dependent on imported milk and milk products. The self-sufficiency for dairy product is 4.5%. In an effort to boost the local dairy industry, the government through the Department of Veterinary Services embarked on a crossbreeding project using 50% Sahiwal – 50% Friesian crossbreds imported from Australia and New Zealand. Through *inter se* mating and backcrossing, a number of Sahiwal - Friesian crossbred groups with 50 - 75% Friesian genes have been produced. This study was carried out to evaluate some of the genetic and non-genetic factors influencing milk production and reproductive performances of these Sahiwal - Friesian breed groups.

This study focused on the dairy unit at the Ladang Pusat Ternakan Haiwan Air Hitam in Johor. Eight breed groups were evaluated, namely M50, M50-1, M50-2, M50-3, M56, M63, M75 and M75-1. Retrospective data on milk production and female reproductive traits of 1585 cows, born between 1981 and 1999, were evaluated. The

composition and quality of milk from 180 cows from six of the breed groups and at three stages of lactation was also analysed.

M75-1 had the highest mean for milk yield per day (MYD) (5.87 - 6.69 kg), milk yield 120 days (MY120) (705- 803 kg), total lactation milk yield (TLDM) (1678 kg), milk yield 305 days (MY305) (1819 kg), lactation length (LL) (261 days), peak milk (PM) (9.93 kg) and days to peak milk (DPM) (49 days). It also had the shortest dry period (DP) (185 days). However, this breed group was not significantly different from M75, M56 and M50-3 for these traits. Maternal additive genetic effects of Friesian genes on MYD, MY120, MY305, TLDM, LL and PM were generally significant ($P<0.05$) and favorable. However, maternal heterosis was negative ($P<0.05$) for TLDM, LL and DPM. Individual heterosis was significant ($P<0.05$) only for MY305. Individual and maternal additive and individual heterotic effects were non significant for DPM and DP. The inverse polynomial function gave a better fit to the lactation data compared to the gamma curve for the breed groups (R^2: 0.27 - 0.54 vs 0.11 - 0.37). With respect to milk composition and quality the effect of breed group was significant ($P<0.05$) only for total acidity (TA). The quality of milk from these Sahiwal - Friesian breed groups met the required standard.

M50-1 had the shortest calving to conception (CCo) (98 days; $P<0.05$) and calving interval (CI) (397 days; $P<0.05$), and required the least number of service per conception (NSC) (2.1). M50-3, M56, M63 and M75-1 had lower age at first heat (AFH), age at first conception (AFCo) and age at first calving (AFCa) and generally

showed similar reproductive performance. Breed group, generally, had no effect on calving to first heat (CFH), gestation length (GL) and calf birth weight (CBW). Maternal additive genetic effect for CCo and individual and maternal heterosis for CCo, CI and NSC were significant ($P<0.05$) and favorable. Both individual and maternal additive genetic effects and heterotic effects were non significant for GL and CBW. Individual additive genetic effect on CFH, CCo and CI and maternal heterotic effect on AFCo and AFCa were unfavorable ($P<0.05$).

The results indicated M50-3, M56, M75 and M75-1 breed groups to have better milk production and reproductive performance. Based on this results, breed groups with 50, 56 and 75% Friesian genes may be used in the dairy industry in Malaysia, provided selection for productivity and reproductive performance and high level of feeding is practised.

Abstrak tesis dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PENCIRIAN TRAIT PRODUKTIVITI KUMPULAN- KUMPULAN BAKA SAHIWAL-FRIESIAN

Oleh

MD. AZHARUL ISLAM TALUKDER

Februari 2002

Penyelia: Jothi Malar Panandam, Ph.D.

Fakulti: Pertanian

Industri tenusu di Malaysia sebahagian besarnya bergantung kepada susu dan produk susu yang diimpot. Paras saradiri bagi produk tenusu hanya 4.5%. Dalam usaha untuk memajukan industri tenusu, kerajaan melalui Jabatan Perkhidmatan Haiwan telah melibatkan diri dengan satu projek pembiakbakaan kacuk menggunakan lembu kacukan 50% Sahiwal – 50% Friesian yang diimpot dari Australia dan New Zealand. Melalui pengawanan *inter se* dan pengacukan balik, beberapa kumpulan lembu kacukan Sahiwal Friesian dengan 50 – 75% gen Friesian telah dihasilkan. Kajian ini telah dijalankan untuk menilai beberapa faktor genetik dan bukan genetik yang mempengaruhi produksi susu dan prestasi reproduksi kumpulan - kumpulan baka Sahiwal Friesien tersebut.

Kajian ini bertumpu kepada unit tenusu di Ladang Pusat Ternakan Haiwan Air Hitam di Johor. Lapan kumpulan kacukan telah dinilai, iaitu M50, M50-1, M50-2, M50-3, M56, M63, M75 dan M75-1. Data retrospektif mengenai produksi susu dan trait reproduksi betina bagi 1585 ekor lembu betina, yang dilahir antara tahun 1981 dan 1999, telah dinilai. Komposisi dan kualiti susu 180 ekor lembu betina daripada enam kumpulan kacukan dan pada tiga peringkat laktasi juga telah dianalisis.

M75-1 mempunyai purata tertinggi bagi hasil susu harian (MYD) (5.87- 6.69 kg), hasil susu 120 hari (MY120) (705 - 803 kg), jumlah hasil susu untuk laktasi (TLDM) (1678 kg), hasil susu 305 hari (MY305) (1819 kg), panjang tempoh laktasi (LL) (261 hari), susu puncak (PM) (9.93 kg), dan bilangan hari ke susu puncak (DPM) (49 hari). Ia juga mempunyai tempoh kering terpendek (DP) (185 hari). Bagaimanapun, kumpulan baka ini tidak berbeza dengan bererti daripada M75, M56 dan M50-3 untuk trait-trait ini. Kesan genetik aditif maternal gen Friesian ke atas MYD, MY120, TLDM, MY305, LL dan PM, secara amnya, adalah bererti ($P<0.05$) dan berfaedah. Tetapi, heterosis maternal adalah negatif ($P<0.05$) untuk TLDM, LL, dan DPM. Heterosis individu hanya bererti ($P<0.05$) untuk MY305. Kesan aditif individu dan maternal dan heterosis individu adalah tidak bererti untuk DPM dan DP. Fungsi 'inverse polynomial' memberi sepadanan yang lebih baik kepada data laktasi berbanding lengkuk 'gamma curve' untuk kesemua lapan kumpulan baka (R^2 : 0.27 - 0.54 vs 0.11 - 0.37). Merujuk kepada komposisi dan kualiti susu, kesan kumpulan baka adalah bererti ($P<0.05$) hanya untuk jumlah keasidan (TA). Kualiti susu daripada kumpulan baka Sahiwal - Friesien mencapai piawaian yang diperlukan.

M50-1 mempunyai kelahiran ke konsepsi (CCo) (98 hari; $P<0.05$) dan selang beranak (CI) (297 hari; $P<0.05$) yang terpendek, dan memerlukan bilangan servis per konsepsi (NSC) (2.1) yang terkurang. M50-3, M56, M63 dan M75-1 mempunyai umur biang pertama (AFH), umur konsepsi pertama (AFCo) dan umur kelahiran pertama (AFCa) yang lebih rendah dan, pada umumnya, menunjukkan prestasi pembiakan yang lebih kurang sama. Kumpulan kacukan, secara umumnya, tidak mempunyai kesan ke

atas tempoh kelahiran hingga biang pertama (CFH), panjang tempoh gestasi (GL) dan berat kelahiran anak (CBW). Kesan aditif genetik maternal untuk CCo dan heterosis individu dan maternal untuk CCo, CI dan NSC adalah bererti ($P<0.05$) dan berfaedah. Kedua-dua kesan aditif genetik individu dan maternal dan heterosis individu dan maternal adalah tidak bererti untuk GL dan CBW. Kesan aditif genetik individu ke atas CFH, CCo dan CI dan kesan heterotik maternal ke atas AFCo dan AFCa adalah bererti merugikan ($P<0.05$).

Keputusan menunjukkan kumpulan baka M50-3, M56, M75 dan M75-1 mempunyai produksi susu dan prestasi reproduksi yang lebih baik. Berdasarkan keputusan ini, kumpulan baka dengan 50, 56 dan 75% gen Friesian patut digunakan dalam industri tenusu di Malaysia, asalkan pemilihan untuk produktiviti dan prestasi pembiakan yang dan taraf pemakanan tinggi diamalkan.

ACKNOWLEDGEMENTS

I would like to express my heartiest gratitude and deep appreciation to Dr. Jothi Malar Panandam, chairman of the supervisory committee, for her advice, invaluable guidance and encouragement throughout the study period.

I would like to extend my gratitude and appreciation to Dr. Halimatun Yaakub, Dr. Ismail Idris and Associate Professor Dr S. Sivarajasingam for their constructive suggestions, guidance and advice towards the completion of this study.

I would like to convey special thanks to Dr. Kazi M. Emdadul Huque, Director General of Bangladesh Livestock Research Institute (BLRI) as well as to my colleagues and friends of the same institute, for their cooperation and moral support.

I would like to acknowledge the Department of Veterinary Services, Ministry of Agriculture, Malaysia and their staff in particular Dr. Sofian Johar, Mr. G. Sivasupramanium, Mr. Adrien K. Raymond, Dr. Roselina, Dr. J. Yahya, Mr. Fauzi, Mr. Zain, Mr. Zani and staff of the Ladang Pusat Ternakan Haiwan Ayer Hitam, Kluang, Johor for their cooperation and help in making this study possible.

I would also like to extend my thanks to Departmental Head, Associate Professor Dr. Zainal Aznam Mohd Jelan, and all staff members of the Depatment of Animal Science, Faculty of Agriculture, and the staff of the Graduate School of

Animal Science, Faculty of Agriculture, and the staff of the Graduate School of Universiti Putra Malaysia for helping me in one way or another towards the completion of the study.

My heartfelt appreciation is also due to my brothers (Jafar Ali, Abdul Khaleque, Akteruzzaman), sister (Late Rezia Khatun), Bhabi (Majeda Khanam), father-in-law (Aftab Uddin Molla), mother-in-law (Rokaya Khatun), uncle (Prof. S. M. Imam Hossain) and other relatives and friends who have always encouraged me during my study period.

My special thanks and appreciation are due to my wife (Arzuman Akhter) and son (T.M. Abu Jawad) for their sacrifice, patience, understanding, help and encouragement throughout the study.

Special thanks goes, to my friends, Dr. Kamaruddin, Dr. Wan Zahari M., Dr. Asad, Dr. Salim, Dr. Mahfuz, Mr. Ersad, Mr. Mollah and Mr. Sukri for their cooperation during the study period.

I would like to acknowledge the funding authority Government of Bangladesh for bearing all expenses of my study through the Agriculture Research Management Project (ARMP), BLRI as per IDA credit 2815 – BD.

I certify that an Examination Committee has met on 7th February 2002 to conduct the final examination of Md. Azharul Islam Talukder on his Doctor of Philosophy thesis entitled "Characterisation of Productivity Traits of Sahiwal - Friesian Breed Groups" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Liang Juan Boo, Ph.D.
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Jothi Malar Panandam, Ph.D.
Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Halimatun Yaakub, Ph.D.
Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Ismail Idris, Ph.D.
Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Mohamed Ariff Omar, Ph.D.
Director
Station Management Centre
Malaysian Agriculture Research
and Development Institute
(Independent Examiner)

SHAMSHER MOHAMAD RAMADILI, Ph.D.
Professor/ Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia
Date: 14 MAR 2002

This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfillment of the requirements for the degree of Doctor of Philosophy.

AINI IDERIS. Ph.D.
Professor/Dean,
School of Graduate Studies
Universiti Putra Malaysia

Date: 09 MAY 2002

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Putra Malaysia or other institutions.

MD AZHARUL ISLAM TALUKDER

Date: 13.3.2002.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AC	Age at calving
AFH	Age at first heat
AFCo	Age at first conception
AFCa	Age at first calving
BG	Breed group (of heifer or cow)
CBW	Calf birth weight
CCo	Calving to conception
CFH	Calving to first heat
CI	Calving interval
CR	Conception rate
Csex	Calf sex
DF	Degree of freedom
DP	Dry period
DPM	Days to peak milk
GL	Gestation length
H_20	Water
h_i	Individual heterosis
h_m	Maternal heterosis
LL	Lactation length
LN	Lactation number
LS	Lactation stage
MBRT	Methylene blue reduction test
MY	Milk yield
MYD	Milk yield per day
MY120	Milk yield for120 days
MY305	Milk yield projected 305 days
NSC	Number of service per conception
PA	Parity
PM	Peak milk
SBG	Sire breed group
SG	Specific gravity
SNF	Solid not fat
TA	Total acidity
TLDM	Total lactation day milk yield
TS	Total solid
YB	Year of birth

CHAPTER 1

INTRODUCTION

The major food type animals reared in Malaysia are poultry, swine, cattle, buffalo, sheep and goat. The livestock sector contributes 4.9% of the GDP per annum (7th Malaysian plan, 1999-2000), 5.2% of the overall agricultural production and food group expected to grow 4.7% per annum in the country (7th Malaysian plan, 1999-2000). Malaysia is currently an exporter of eggs, poultry meat and pork. The dairy, beef, mutton and chevon sectors of the livestock industry, however, are less developed, although the total population of ruminant has increased over the last decade.

The cattle population in the Peninsula of Malaysia is approximately 660,643; of this 43,087 are dairy cattle (DVS, 1998). Most of these cattle are poor milk producers. The total milk production for the 1998 was reported to be only 27.28 million litres, whereas the consumption was 611.31 million litres (DVS, 1998). The self- sufficiency for milk is 4.5% (DVS, 1998). The deficiency of milk and milk products in Malaysia is 95.5% (DVS, 1998). The dairy market in Malaysia is mainly dependent on imported milk and milk products. The import of dairy products leads to loss of foreign exchange.

The demand for livestock products as a source of high quality protein is expected to continue to rise with the increase in population and per capita income, consistent with the overall rapid development of the country. It is not realistic to expect

that all the requirements for livestock products be produced locally; there will be pressure to reduce food importation in the context of food security and saving foreign exchange. The challenge for the livestock industry is to increase the local production of livestock products in areas where it is economically viable.

By the year 2000 Malaysia had targeted to achieve 10% self-sufficiency in liquid milk. The targeted production by the year 2000 was 49.5 million litres (7^{th} Malaysian plan, 1999-2000). By the year 2010 it is hoped Malaysia would achieve 30% self-sufficiency for liquid milk (7^{th} Malaysian plan, 1999-2000). In order to realise these targets, the government embarked on a crossbreeding programme involving the Sahiwal and Friesian dairy cattle breeds (Osman, 1993). It was hoped that with substantial increase in the number of improved dairy cattle the supply of milk and milk products from local sources would increase. Higher yields from the improved cattle will encourage local farmers to participate with greater interest in dairy cattle production and, thereby, boost the industry. The Department of Veterinary Services imported a large number of Sahiwal × Friesian crosses (F_1) and purebreed Friesians from Australia and New Zealand in 1978 (Sivarajasingam *et al.*, 1982). The crossbreeding programme aimed to grade up the crossbreds by continual crossing with Friesian, and breed groups with 50, 56.25, 62.5 and 75% Friesian genes have been produced.

Productivity is the major factor in the profitability of a dairy herd. Productivity is estimated based on the milk output of the herd and the cost of herd depreciation. In any crossbreeding programme, the crossbreed groups produced must be evaluated with

respect to their productivity, and the genetic and non-genetic factors influencing their productivity should be identified. Only by doing so, can the crossbreed group that is most productive be identified and be adopted as a commercial dairy animal. Taking these into consideration, this study was designed with the following objectives.

1.1. Objective of the Study

The objectives of this study was to characterise and compare the productivity traits of Sahiwal - Friesian crossbred cows with 50, 56.25, 62.5 and 75% Friesian genetic background.

The specific objectives of the study were:

1 To evaluate effect of breed group and lactation number on milk production traits of eight Sahiwal - Friesian breed groups.

2 To compare the lactation curves of the Sahiwal - Friesian breed groups.

3 To evaluate the effect of breed group and parity on the reproductive performance of Sahiwal - Friesian cows.

4 To evaluate the additive and heterotic effects of the Sahiwal - Friesian cross on the milk production and female reproductive traits.

5 To evaluate the effect of breed group and lactation stage on the milk quality of six Sahiwal - Friesian breed groups.

1.2 Significance of the Study

By evaluating and comparing the milk production and reproductive performances of the Sahiwal – Friesian crossbreed cattle with different degrees of

Friesian genetic background, the most productive Sahiwal - Friesian crossbreed group or groups may be identified. The information from this study would be useful for designing breeding programme for production of more productive commercial dairy herds and, thereby, increase the milk production and the income of dairy farmers.

The knowledge of the milk production trends across various stages of lactation would help the dairy breeders to evaluate the genetic potential of the cow. This would facilitate culling of low producing cows and selecting the herd replacement.

Analysis of the constituents and quality of the milk from the Sahiwal - Friesian crossbreeds will determine if this meets the required standard.